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H04L 12/40

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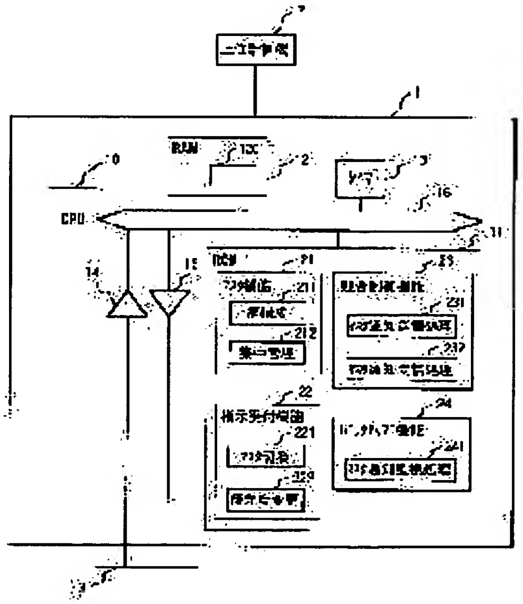
(54) COMMUNICATION CONTROLLER, COMMUNICATION NETWORK AND ITS CONTENTION CONTROL METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To control only one master to be processed without contention even when plural masters are erroneously in existence on the same line.

SOLUTION: Each control station 1 has a master function 21 so as to be a master by a command from a host computer 2. A station 1 being a master station publicates and broadcasts a master notice including its own priority at a prescribed period. On the other hand, a control station 1 receiving the master notice, when its own status indicates a master, compares the priority of master notice with its own priority and becomes a slave when its own priority is lower.



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[Date of sending the examiner's decision of rejection]

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CLAIMS

[Claim(s)]
[Claim 1] In the network where one of two or more of the communication controllers communicates data by token passing access by becoming a master with the command of a high order the communication controller of a master Other communication controllers which transmitted the notice of a master including that self is a master and a priority with the predetermined period, and received said notice of a master The contention control approach of the network which self is a master, and is characterized by shifting to a slave when an own priority is lower than the priority of the notice of a master concerned.
[Claim 2] In the network which transmits the communication link frame in which one of two or more of the communication controllers contains data by token passing access by becoming a master with the command of a high order Other communication controllers which the communication controller of a master transmitted said communication link frame including that self is a master and a priority with the predetermined period, and received said communication link frame The contention control approach of the network which the communication link frame concerned is a thing from a master, and is characterized by shifting to a slave when self is also a master, and an own priority is lower than the priority of the communication link frame concerned.
[Claim 3] It is the contention control approach of the network characterized by setting up said predetermined period by N times the token period in claims 1 or 2.
[Claim 4] In the network which performs the communication link by token passing by one of two or more of the communication controllers becoming a master with the command of a high order The communication controller of a master transmits the notice of a master including an own priority with a period N times the period of a token. other communication controllers which received said notice of a master -- self -- a master -- and The contention control approach of the network which shifts to a slave when an own priority is lower than the priority of the notice of a master concerned, and is characterized by returning the response of said notice of a master and highly uniform at the time of the next token detection when an own priority is higher than the priority of the notice of a master concerned.
[Claim 5] The contention control approach of the network characterized by the communication controller of a slave shifting to a master when there is no transmission which shows that said self is a master beyond a fixed period in a network in any 1 term of claims 1-4.
[Claim 6] In the communication controller which is connected to a transmission line, and sends and receives a communication link frame by token passing access With a master functional processing means to perform a network network configuration and a network centralized control, and the master directions from a host computer The master switch means which switches the own status to a master, and a notice of master transmitting processing means to publish the notice of a master including that self is a master and a priority, The communication controller characterized by establishing the notice reception means of a master which makes self a slave when the own priority is lower than the priority of the notice of a master which received.
[Claim 7] The communication controller characterized by establishing a priority modification processing means to change an own priority, with the priority modification directions from a host computer in claim 6.
[Claim 8] The communication controller characterized by forming the timer which sets up the issue period of said notice of a master by N times the token period in claims 6 or 7.
[Claim 9] The communication controller characterized by shifting the own status to a master when the notice monitor means of a master which said notice of a master supervises is established in claim 6, or 7 or 8 and the notice of a master is not detected beyond a fixed period.

[Claim 10] In the communication network which performs network configuration control by token passing access by connecting two or more control stations through a transmission line, and the control station of arbitration specified by the command from a high order serving as a master Said control station is a communication controller characterized by having established a contention control means to shift to a slave when an own priority is lower than the priority of said notice of a master which received, while transmitting the notice of a master including that self is a master and a priority.
[Claim 11] Said control station is a communication controller characterized by having established a backup means by which self shifts to a master when said notice of a master is not detected beyond a fixed period in claim 10.
[Claim 12] It is the communication controller characterized by having established a priority modification means for said control station to change a priority with the command from a high order in claims 9 or 10, and to change the master in a network.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a contention control method in case two or more masters exist about the communication network which carries out centralized control of the inside of a transmission line by the only master, and its communication controller.
[0002]
[Description of the Prior Art] With the telecommunications control system which consists of two or more control stations, there is an access method by the command from a host computer as an approach of determining a network master control station as only.
[0003] In this method, master control directions are published from a host computer with the master directions function by the user program to the control station of the low order linked to self. Self serves as a master, and the control station which received these directions builds a logical ring, transmits the token for a communication link, and a network is started. Then, configuration control, such as the loop back, and the centralized control of a system are performed.
[0004]
[Problem(s) to be Solved by the Invention] With the above-mentioned conventional technique, accidentally [user program / of another host computer], by signal transformation, if master control directions are published to the low order control station, two or more master control stations exist in one network. Moreover, if failure is produced to a master control station, since backup by other control stations is not taken into consideration, the master in a network becomes absent. In such a case, there was a trouble that it became impossible to perform a normal network configuration and its centralized control.
[0005] Furthermore, when the master function of other control stations was checked, the master control station needed to be turned off before the maintenance service, and there was a trouble that information required for a system management disappeared.
[0006] The purpose of this invention conquers the trouble of the conventional technique, and is to offer a backup method when a contention control method and a master control station in case two or more masters exist in one transmission line become absent.
[0007] Furthermore, it is in offering the communication controller and communication network which realize these all directions type (or the combination).
[0008]
[Means for Solving the Problem] In the network which communicates data by token passing access by one of two or more of the communication controllers becoming a master with the command of a high order in order that this invention may attain the above-mentioned purpose The status data which, as for the CCE of a master, self shows that it is a master, The notice of a master including an own priority is transmitted with a predetermined period, and self is a master, and other communication controllers which received said notice of a master are characterized by shifting to a slave, when an own priority is lower than the priority of the notice of a master concerned.
[0009] The above-mentioned notice of a master is performed using the transmitting frame for the frame of dedication, or the usual data transmission. The transmitting period of the notice of a master is set up by N times the token period, and when the token is owned, it is broadcast.
[0010] Moreover, self is a master, and other communication controllers with which this invention received the

notice of a master shift to a slave, when an own priority is lower than the priority of the notice of a master concerned, and when an own priority is higher than the priority of the notice of a master concerned, they are characterized by returning the response of said notice of a master and highly uniform at the time of the next token detection. Contention control is performed promptly, without waiting for the notice period of a master, since the master which received the response shifts to a slave immediately by this.
[0011] Furthermore, in a network, this invention is characterized by the communication controller of a slave shifting to a master, when there is no transmission of the notice of a master beyond a fixed period. Network operation is continuable with this backup. In addition, when two or more masters arise, it is controlled by backup by only by the above-mentioned contention control.
[0012] The communication controller which has the priority-control function of this invention With a master functional processing means to perform a network network configuration and a network centralized control, and the master directions from a host computer The master switch means which switches the own status to a master, and a notice of master transmitting processing means to publish the notice of a master including that self is a master and a priority, When the own priority is lower than the priority of the notice of a master which received, it is characterized by establishing the notice reception means of a master which makes self a slave.
[0013] It is characterized by the communication network which connects two or more communication controllers of this invention having established a backup means by which self shifts to a master, when having established a priority modification means changing a priority with the command from a high order, and changing the master in a network, and/or said notice of a master are not detected beyond a fixed period.
[0014] After communication link actuation begins while two or more master control stations have existed in one transmission line accidentally when communication link actuation has begun according to a temporary failure according to such this invention and, incorrect issue of the master control command from a computer etc. enables it to make a master control station only, also when the master control station has existed in others.
[0015] Moreover, when a master control station becomes absent by failure etc., backup of other slave control stations is attained.
[0016] Furthermore, since the control station which gains a master is changed that it is not fixed and easily, in maintenance, a master is moved to other control stations where the priority in telecommunications control system is low, and it becomes possible to check the function of the low control station of a priority.
[0017]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained according to a drawing.
[0018] Drawing 2 is the network of the telecommunications control system which applies this invention. Each communication controller (below, it is called a control station) 1 connected to the computer 2 of a high order is equipped with the function which communicates between stations via a transmission line 3 by token passing access. Here, although the looping network was shown, it is applicable also to a bus mold or a star mold.
[0019] Drawing 1 is the block diagram showing the configuration of the control station of a command directions mold. A control station 1 has connected the timer 13 for operating periodically RAM12 and the control program which stores the central processing unit (CPU) 10 which controls actuation of the control station 1 according to a control program, and various kinds of control programs, and stores ROM11, transmission/receiving frame, etc. which realizes a master function, a contention control function, etc. with CPU10, the receiving circuit 14 which receives a frame from a transmission line 3, and the sending circuit 15 which transmits a frame to a transmission line with an internal bus 16. In addition, configurations of the common knowledge with which the conventional control station is equipped, such as detection, creation, etc. of a token or a communication link frame, are omitted.
[0020] What realizes the master function 21, the directions reception function 22, the contention control function 23, and the backup function 24 is contained in the control program stored in ROM11. RAM12 has the managed table 120 which remembers a priority to be the status (a master/slave) of a continence station.
[0021] In the master function 21, it has the network configuration processing program 211 by the logical ring, and the network centralized-control processing program 212, and the conventional master station possesses in it.
[0022] The directions reception function 22 has the master change-over processing program 221 which changes the master command from a host computer 2 to a ****** master, and the priority modification processing

program 222 which receives a priority modification command similarly and changes the priority of a self-station.

[0023] The flow chart of master change-over processing is shown in drawing 3 . The master change-over processing program 21 is started by the command by the user program of a host computer. First, the command from a high order judges in master directions (s101). If it is master directions, a self-station will judge in a slave (s102), if that is right, the status of a self-station will be switched to a master and a master will be registered into the managed table 120 (s103). Then, while starting the master function 21 and performing predetermined network configurations, such as logical ring construction, a network centralized control is performed.

[0024] The flow chart of priority modification processing is shown in drawing 4 . The priority strange processing program 222 is started by the command from a host computer. First, the command from a high order judges in priority modification (s201), if that is right, a priority will be extracted from a modification command (s202), and the priority will be set as the managed table 120 (s203). (modification)

[0025] Thus, since the control station of arbitration is made with the only master like the after-mentioned by changing the priority of each control station 1, modification, maintenance check, etc. of a system configuration become easy.

[0026] In addition, the station address of each control station proper is set to a priority, and a priority may be made to descend to it from the upstream one by one towards a lower stream of a river (or rise).

[0027] Each control station 1 transmits a communication link frame to a transmission line 3, when self owns the token, patrolling a token according to the logical ring constituted by the master (detection). The data of a communication link frame are passed from a host computer 2. At this time, other control stations are incorporated when the communication link frame from a transmission line 3 is addressing to itself, they decode those contents, and pass them to the computer 2 of a high order.

[0028] A format of a communication link frame is shown in drawing 5 (a). a communication link -- a frame -- a frame -- initiation -- expressing -- a start -- a delimiter -- (-- SD --) -- 101 -- a frame -- classification -- expressing -- a function code -- (-- FC --) -- 102 -- a phase -- a hand -- the address -- it is -- a destination -- the address -- (-- DA --) -- 103 -- transmission -- origin -- the address -- it is -- a source address -- (-- SA --) -- 104 -- a calculating machine -- two -- from -- having received -- information -- depending -- variable length -- data (Data) -- 105 -- a frame -- error detection -- a sake -- a bit string -- it is -- frame check sequence (FCS) -- 106 -- a frame -- termination -- expressing -- an end -- a delimiter -- (-- ED --) -- 107 -- from -- constituting -- having --.

[0029] The master control station in this network transmits the notice frame of a master to a transmission line 3 periodically by the contention control function 23, and each control station avoids contention of a master for the priority of oneself and others as follows as compared with whenever [which receives the notice frame of a master].

[0030] Drawing 6 is a flow chart which shows transmitting processing of the notice frame of a master. The notice of master transmitting processing program 231 is based on the master function 21, and is started, simultaneously is started. First, a continence station judges whether it is the period which transmits the notice frame of a master (s301). This judgment is set up by N times the token period, and when it shifts to a master, it is based on the clock generated from a timer 13 from from. If it is a transmitting period, the notice frame of a master will be created (s302), and it will transmit to a transmission line 3 via a sending circuit 5 (s303). It is the timing of transmission at the token detection time, and it is broadcast separately from a transmitting frame.

[0031] A format of the notice frame of a master is shown in drawing 5 (b). Compared with the communication link frame of this drawing (a), it does not have data (Data) 105 but the priority (PRI) 108 is included instead. The classification of a function code 102 expresses the notice frame of a master, and all stations consider the destination address (DA) 103 as the target broadcasting.

[0032] Drawing 7 is a flow chart which shows the reception of the notice frame of a master. The reception program 232 of the notice frame of a master is started whenever the notice frame of a master is received by the receiving circuit 14.

[0033] First, a continence station judges whether it is a master control station (s401). If it is not a master, actuation will be continued as it is. If it is a master, the priority of the received notice frame of a master and a continence station is measured (s402), and when the priority of the notice frame of a master is higher than a continence station, a continence station will shift to a slave (s403). When the priority of a continence station is high, actuation is continued as a master as it is (s404).

[0034] Drawing 8 is a timing diagram which shows actuation of the communication control system by this operation gestalt. If Station STa changes from Computer a to a master in response to master directions at time of day t1, it will publish the notice frame of a master and will repeat to every transmitting period T1 (N times of a token period) henceforth.

[0035] If the master directions which were mistaken from Computer b to Station STb at time of day t2 are made, STb will change to a master and will publish the notice frame of a master. In this condition, the master of STa and STb exists in a transmission line. STa receives the notice frame of a master from STb, measures the priority of STa, and the priority of STb, and since the own priority is higher, it maintains a master. After Tt1+1, the notice frame of a master is published from STa. As compared with the priority of STa, STb admits that an own priority is low and changes to a slave (time of day t3).

[0036] In addition, although the notice frame of a master of dedication was used above, it is realizable with the usual communication link frame. Drawing 5 (c) is a format of a communication link frame including the notice of a master. That is, the priority (PRI) 108 is added with INFO109 which shows that the continence station which transmits a frame to the usual frame of drawing 5 (a) is a master.

[0037] Also when a master control station does not have transmit data at every transmission of this transmitting frame desirably, whenever it carries out predetermined time (token period xN) progress, it is transmitted, and on the other hand, self is a master, and other control stations which received the transmitting frame from a master are changing to a slave, if a priority's is low, and can avoid contention of a master like the above.

[0038] As mentioned above, according to this operation gestalt, master control stations are self's being a master and notifying the priority periodically, and can control a master to only. According to this, by an assignment mistake, data transformation, etc. of a user program, when two or more master control stations exist in one transmission line, contention of a master can be avoided and a normal network configuration and a normal centralized control can be maintained.

[0039] Moreover, since migration of a master can carry out easily by changing the priority of each control station actively from the computer of a high order, modification and maintenance check of a system configuration become easy. For example, the high control station of a priority does not need to set essentially new on a network, or the management information of a system which the current master control station holds since a master will not move if the priority of a subscription station is set up low when re-joining as a subscription station by failure recovery etc. rather than a master control station.

[0040] Furthermore, since it is not necessary to turn off the control station which was a master when shifting a master to others, disappearance of information required for the system management held as a master can be prevented.

[0041]

[Example] Next, other examples of this invention are explained. Drawing 9 is a flow chart which shows the reception of the notice frame of a master by this example. Below, only difference with the above-mentioned example (drawing 7) is explained.

[0042] In this example, it measures the priority of the received notice frame of a master, and the priority of a continence station (s502), and when the priority of a continence station is high, it creates the response frame of the same format as the notice frame of a master to the transmitting origin of the notice frame of a master (s504), and it not only continues the actuation as a master (s506), but transmits to a transmitting agency (s505).

[0043] Drawing 10 is a timing diagram which shows actuation of the communication control system by this example. At time of day t1, Station STa changed from Computer a to the master in response to master directions, and has published the notice frame of a master for Tevery transmitting period.

[0044] At time of day t2, in response to the directions which Station STb mistook, it changes to a master, and the notice frame of a master is published. If the notice frame of a master from STb is received, the master station STa will judge with an own priority being high by comparison, and will maintain a master. With it, the response frame of the same format as the notice frame of a master is transmitted to t3 at STb at the time of detection of the next token. At the time of day t4 after few transit delays, STb will know existence of a master with a priority higher than self, and changes to a slave.

[0045] If according to this the mistaken notice frame of a master is received when the transmitting period of the notice frame of a master is N times the token period, since a response frame will be returned at the time of the token detection just behind that, master contention is promptly avoidable. In addition, in this example, it cannot be overemphasized that it is not based on the notice frame of a master of dedication, but the communication link frame with the notice of a master of drawing 5 (c) can be used.

[0046] Next, the example of further others is explained. Drawing 11 R> 1 is a flow chart which shows the backup function by this example. As shown in this drawing (a), the notice monitor processing program 241 of a master starts for every reception of the notice frame of a master, and restarts a watchdog timer (s601). The time-out of a watchdog timer exceeds the period of for example, the notice frame of a master, and is set to under 2 double [the].

[0047] If the time-out of a watchdog timer is supervised (s701) and there is no reception of the notice frame of a master by time-out time amount as shown in this drawing (b), a continence station will shift to a master control station (s702).

[0048] Drawing 12 is a timing diagram which shows actuation of the communication control system by this example. Master STa publishes the notice frame of a master a period T1, and whenever Slave STb receives the notice of a master, it is resetting the time-out T2 (T2> T1). If a failure occurs in Master STa (x mark) and a time-out T2 is exceeded, Slave STb will change to a master, will carry out notice frame issue of a master immediately, and will be repeated the issue period T1 henceforth. Therefore, it will be controlled by the above-mentioned contention control by only even if two or more slave control station changes to a master.

[0049] Since according to the notice frame monitor processing of a master of this example backup by other stations is automatically performed in the telecommunications control system by command assignment when a master control station becomes absent from a transmission line according to some causes, such as failure, actuation of telecommunications control system is continuable.

[0050]

[Effect of the Invention] Since according to this invention a master control station is controlled so that the notice of a master which added the own priority is performed a predetermined period to other stations and only the station where a priority is the highest continues a master, the abnormal condition to which two or more master control stations exist in one transmission line accidentally is avoided, and it is effective in a normal network configuration and a normal centralized control being maintainable.

[0051] Moreover, since the master with a high priority answers the notice of a master which added the self-priority at the time of the next token detection when the notice of a master from a master with a low priority is received, a low master can change to a slave and has the effectiveness which can cancel promptly two or more masters on a transmission line.

[0052] Since a self-station is switched to a master when the notice of a master cannot be detected according to this invention, even if a slave control station supervises the notice of a master which flows to a transmission line and carries out fixed time amount progress, the absence of the master by failure etc. is backed up and there is effectiveness which can continue actuation of a system.

[0053] Moreover, since it enables it to set up or change actively the priority which the master directions to each control station and each own from the computer of a high order, a master can be moved to the control station of arbitration and there is effectiveness which makes easy modification of a system and maintenance check of a control station.

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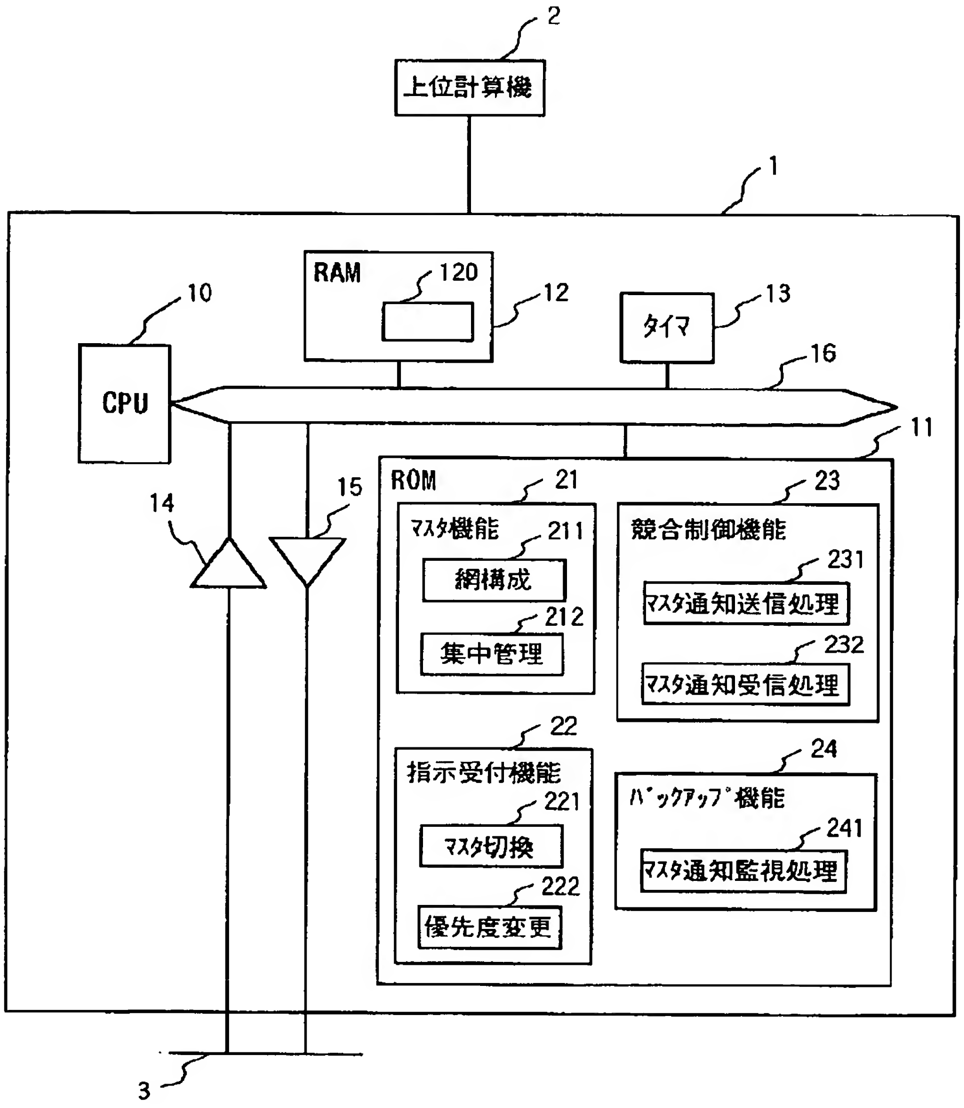
DRAWINGS

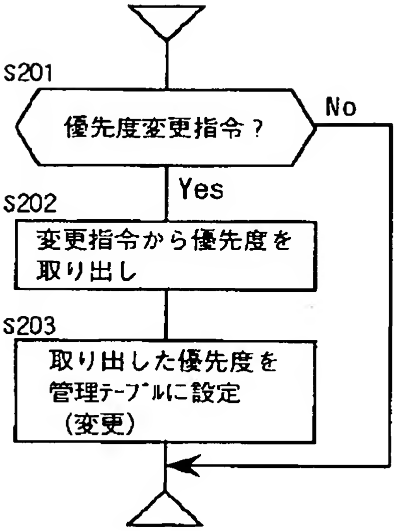
[Drawing 1]

図 1


2
上位計算機
1
RAM
120
12
10
ﾀｲﾏ
13
16
CPU
11
ROM
21
23
14
15
ﾏｽﾀ機能
211
網構成
212
集中管理
競合制御機能
231
ﾏｽﾀ通知送信処理
232
ﾏｽﾀ通知受信処理
22
指示受付機能
221
ﾏｽﾀ切換
222
優先度変更
24
ﾊﾞｯｸｱｯﾌﾟ機能
241
ﾏｽﾀ通知監視処理
3

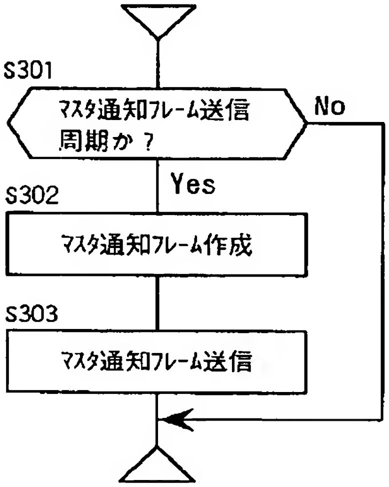
[Drawing 4]

図 4


S201
優先度変更指令？
No
Yes
S202
変更指令から優先度を取り出し
S203
取り出した優先度を管理ﾃｰﾌﾞﾙに設定（変更）

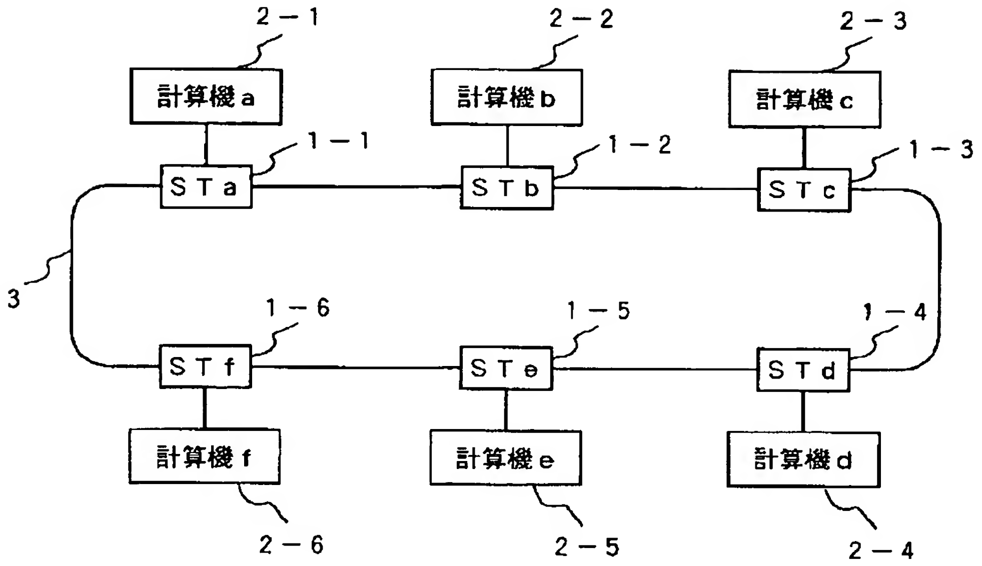
[Drawing 6]

図 6


S301
ﾏｽﾀ通知ﾌﾚｰﾑ送信周期か？
No
Yes
S302
ﾏｽﾀ通知ﾌﾚｰﾑ作成
S303
ﾏｽﾀ通知ﾌﾚｰﾑ送信

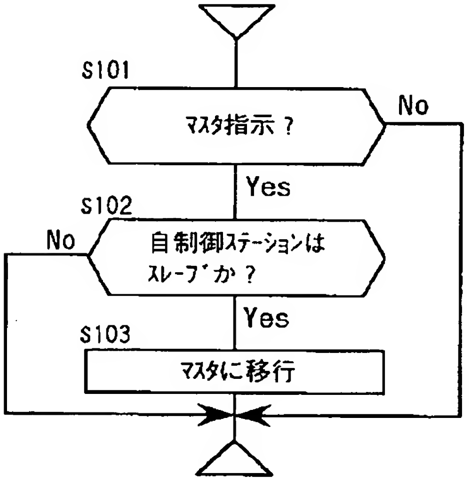
[Drawing 2]

図　2


2－1
2－2
2－3
計算機 a
計算機 b
計算機 c
1－1
1－2
1－3
S T a
S T b
S T c
3
1－6
1－5
1－4
S T f
S T e
S T d
計算機 f
計算機 e
計算機 d
2－6
2－5
2－4

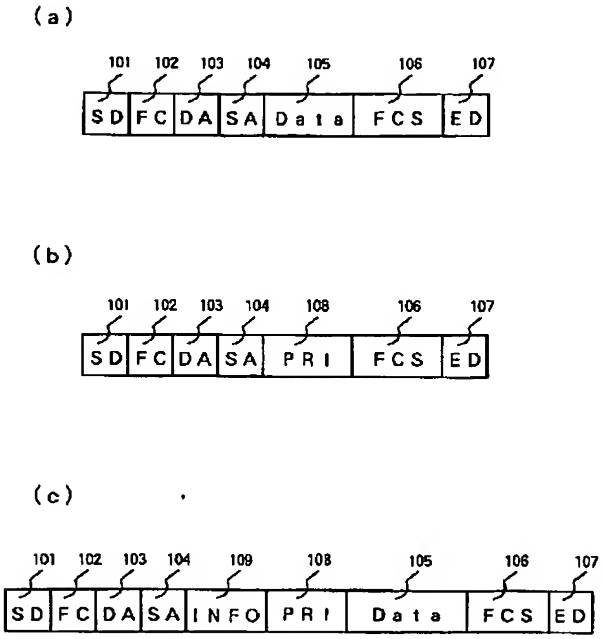
[Drawing 3]

図　3


S101
ﾏｽﾀ指示？
No
Yes
S102
No
自制御ｽﾃｰｼｮﾝは ｽﾚｰﾌﾞか？
Yes
S103
ﾏｽﾀに移行

[Drawing 5]

図 5


(a)
101
102
103
104
105
106
107
SD
FC
DA
SA
Data
FCS
ED
(b)
101
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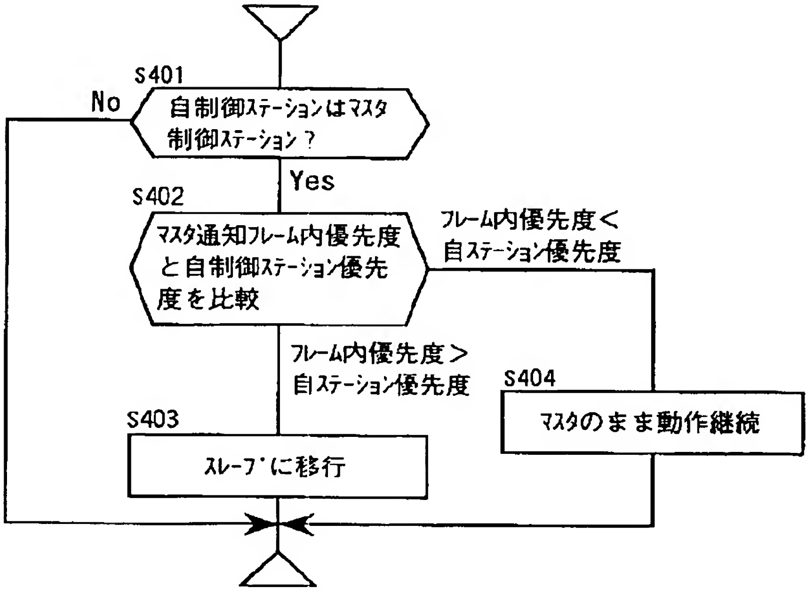
103
104
108
106
107
SD
FC
DA
SA
PRI
FCS
ED
(c)
101
102
103
104
109
108
105
106
107
SD
FC
DA
SA
INFO
PRI
Data
FCS
ED

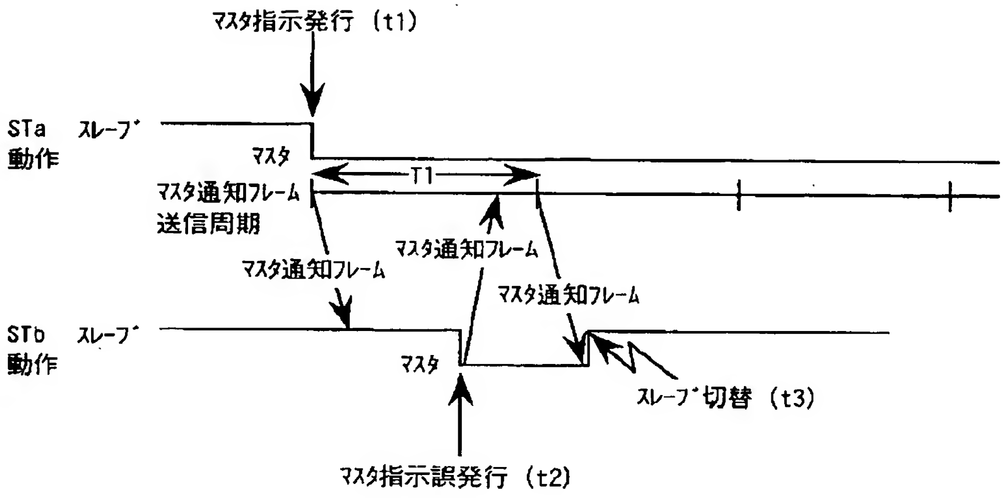
[Drawing 7]

図 7


S401
自制御ｽﾃｰｼｮﾝはﾏｽﾀ制御ｽﾃｰｼｮﾝ？
No
Yes
S402
ﾏｽﾀ通知ﾌﾚｰﾑ内優先度と自制御ｽﾃｰｼｮﾝ優先度を比較
ﾌﾚｰﾑ内優先度＜自ｽﾃｰｼｮﾝ優先度
ﾌﾚｰﾑ内優先度＞自ｽﾃｰｼｮﾝ優先度
S403
ｽﾚｰﾌﾞに移行
S404
ﾏｽﾀのまま動作継続

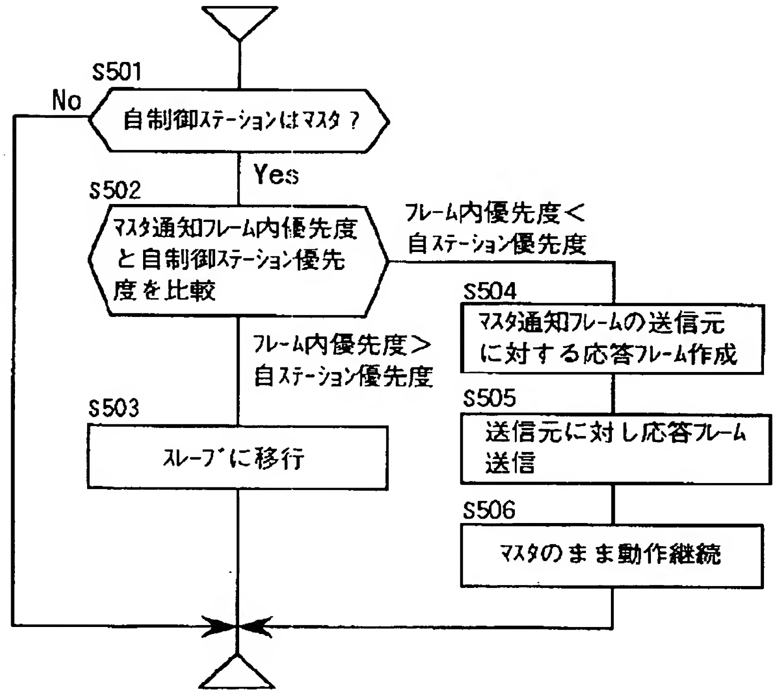
[Drawing 8]

図 8


ﾏｽﾀ指示発行（t1）
STa ｽﾚｰﾌﾞ
動作
ﾏｽﾀ
T1
ﾏｽﾀ通知ﾌﾚｰﾑ
送信周期
ﾏｽﾀ通知ﾌﾚｰﾑ
ﾏｽﾀ通知ﾌﾚｰﾑ
ﾏｽﾀ通知ﾌﾚｰﾑ
STb ｽﾚｰﾌﾞ
動作
ﾏｽﾀ
ｽﾚｰﾌﾞ切替（t3）
ﾏｽﾀ指示誤発行（t2）

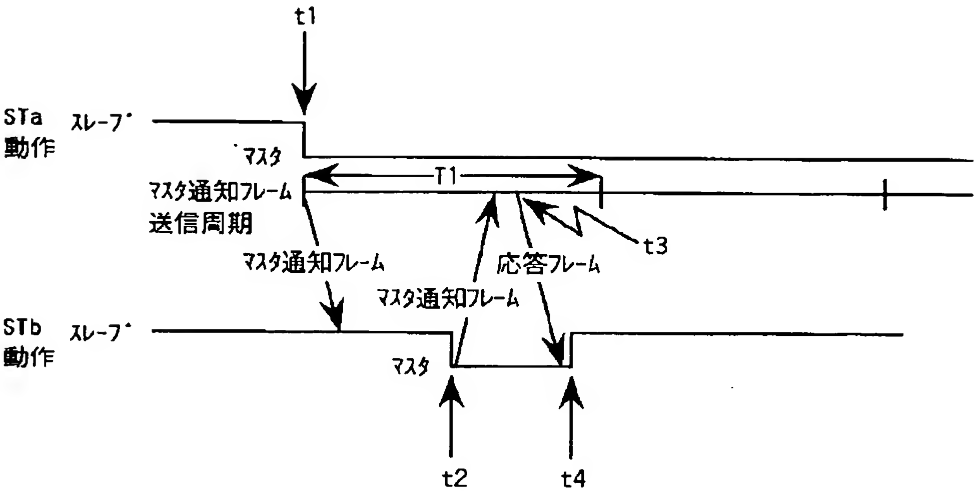
[Drawing 9]

図 9


S501
No
自制御ｽﾃｰｼｮﾝはﾏｽﾀ？
Yes
S502
ﾏｽﾀ通知ﾌﾚｰﾑ内優先度と自制御ｽﾃｰｼｮﾝ優先度を比較
ﾌﾚｰﾑ内優先度＜自ｽﾃｰｼｮﾝ優先度
ﾌﾚｰﾑ内優先度＞自ｽﾃｰｼｮﾝ優先度
S503
ｽﾚｰﾌﾞに移行
S504
ﾏｽﾀ通知ﾌﾚｰﾑの送信元に対する応答ﾌﾚｰﾑ作成
S505
送信元に対し応答ﾌﾚｰﾑ送信
S506
ﾏｽﾀのまま動作継続

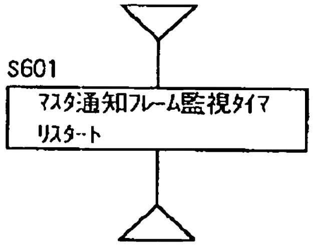
[Drawing 10]

図　１０

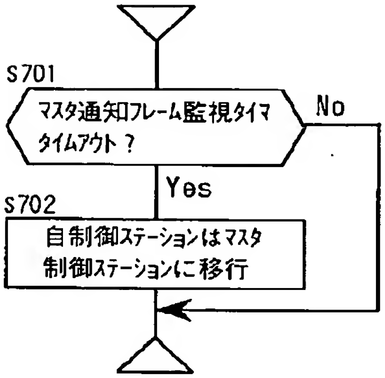

t1
STa 動作
ｽﾚｰﾌﾞ
ﾏｽﾀ
ﾏｽﾀ通知ﾌﾚｰﾑ 送信周期
T1
ﾏｽﾀ通知ﾌﾚｰﾑ
応答ﾌﾚｰﾑ
t3
ﾏｽﾀ通知ﾌﾚｰﾑ
STb 動作
ｽﾚｰﾌﾞ
ﾏｽﾀ
t2
t4

[Drawing 11]
図　１１

（ａ）

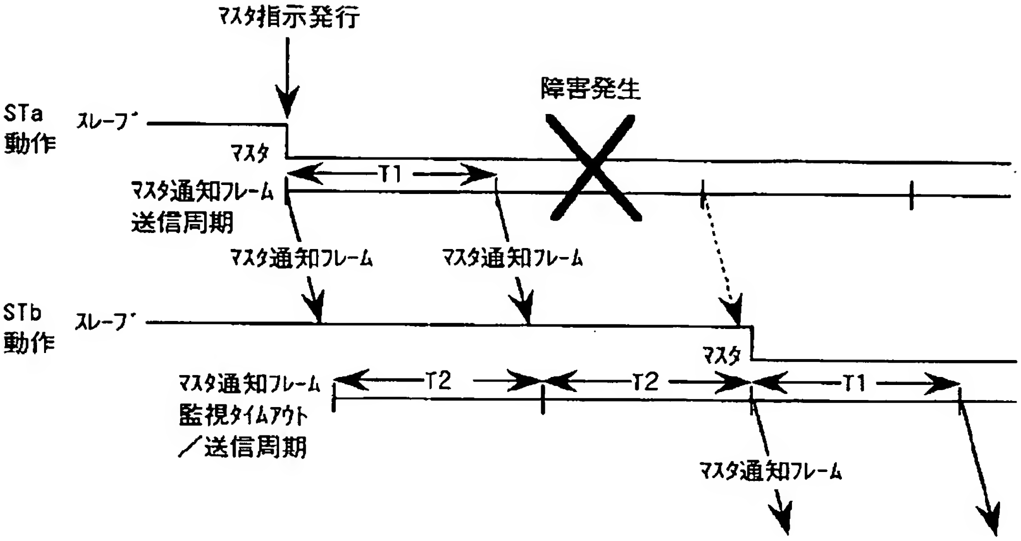

S601
ﾏｽﾀ通知ﾌﾚｰﾑ監視ﾀｲﾏ ﾘｽﾀｰﾄ

（ｂ）


S701
ﾏｽﾀ通知ﾌﾚｰﾑ監視ﾀｲﾏ ﾀｲﾑｱｳﾄ ?
No
Yes
S702
自制御ｽﾃｰｼｮﾝはﾏｽﾀ制御ｽﾃｰｼｮﾝに移行

[Drawing 12]

図 １２


マスタ指示発行
障害発生
STa
動作
スレーブ
マスタ
T1
マスタ通知フレーム
送信周期
マスタ通知フレーム
マスタ通知フレーム
STb
動作
スレーブ
マスタ
マスタ通知フレーム
監視タイムアウト
／送信周期
T2
T2
T1
マスタ通知フレーム

[Translation done.]